HICKOK

JAN 8 1963

QC CAL/CERT
PROCEDURES
GROUP COPY

OPERATING INSTRUCTIONS
FOR
CRYSTAL CONTROLLED MICROVOLT SIGNAL GENERATOR
MODEL 292X
MODEL 292X-AL

THE HICKOK ELECTRICAL INSTRUMENT COMPANY · 10514 Dupont Avenue, Cleveland 8, Ohio

OPERATING INSTRUCTIONS
FOR
CRYSTAL CONTROLLED MICROVOLT
SIGNAL GENERATOR
MODEL 292X
MODEL 292X-AL

Manufactured by

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10514 DUPONT AVENUE

CLEVELAND 8, OHIO

Litho U.S.A.

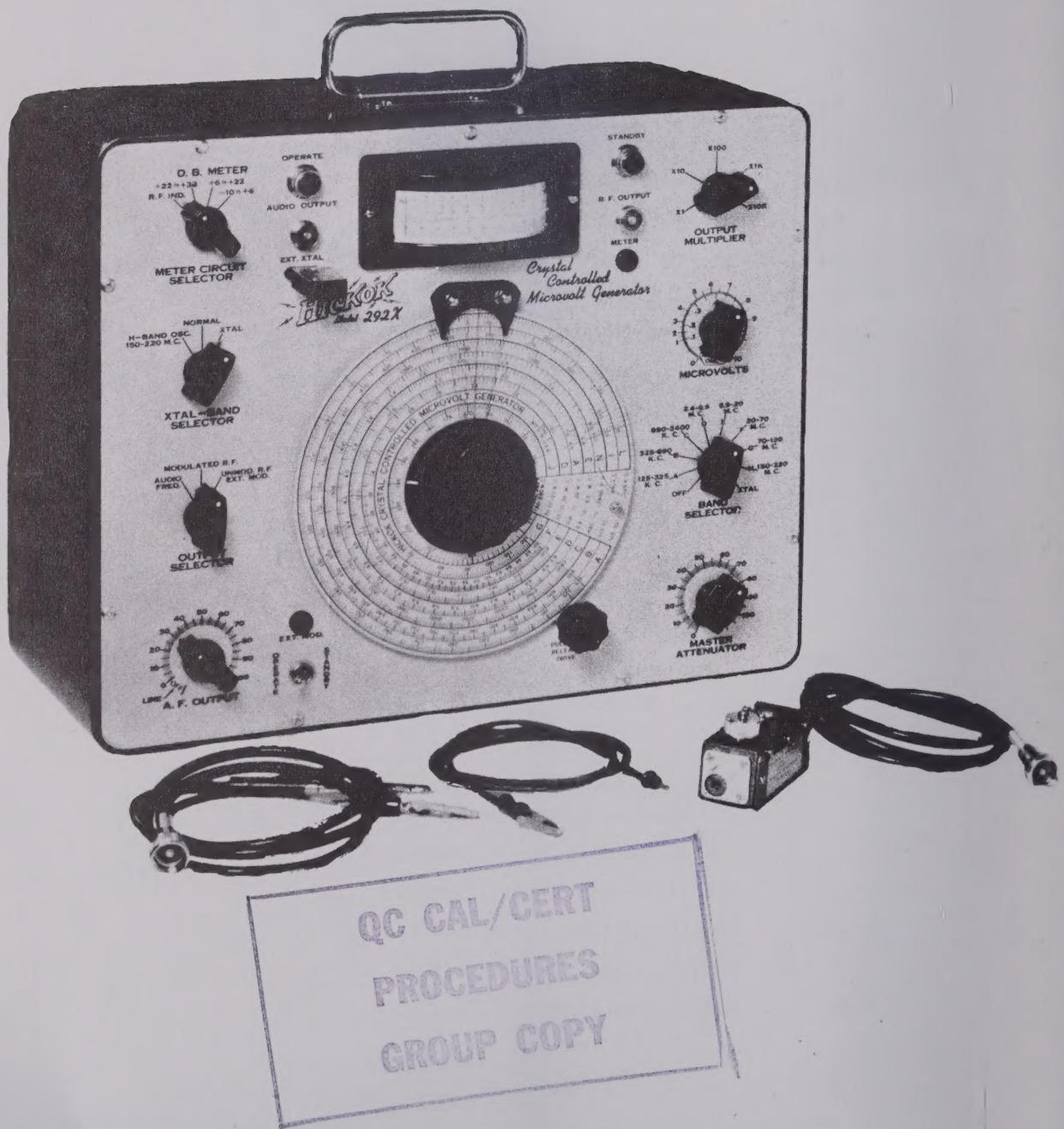
2490-173

TABLE OF CONTENTS

Paragraph	Title	Page
1.1	Purpose	1
1.2	Brief Description	1
2.1	Installation	1
2.2	Preliminary Checks in Regard to Operation	1
2.3	Operation	3
3.1	Main Variable Oscillator—125 kc. to 120 mc.	5
3.2	H-Band Oscillator—150 to 220 mc.	5
3.3	400 Cycle Oscillator-Modulator	5
3.4	External Crystal	5
3.5	Microvolt Metering Circuit	5
3.6	Output Multiplier-Microvolts Network	6
3.7	Power Supply	6
3.8	D. B. Meter	6
4.1	General	6
4.2	Tube Maintenance	6
4.3	Realignment	6
	Parts List	9

LIST OF ILLUSTRATIONS

Figure	Title	Page
1.1	Crystal Controlled Microvolt Signal Generator, Model 292X	ii
1.2	Basic Circuit, Block Diagram, Model 292X	2
2.1	Type 20DB (10:1 Voltage) Attenuator	4
4.1	Power Supply Chassis, Model 292X	7
4.2	R-F Chassis, Model 292X, Right View	8
6.1	Schematic, Model 292X	12



QC CAL/CERT
PROCEDURES
GROUP COPY

Figure 1.1—Crystal Controlled Microvolt Signal Generator, Model 292X

TECHNICAL DATA SHEET

Quan.	*Name*	*Type*	*Stock No.*	*Dimensions*	*Weight*
1	Crystal Controlled Microvolt Signal Generator	292X	902-185	13" x 16" x 7"	33 lbs.
1	Instruction Book		2490-173		
1	Output Cable		3030-41	48"	
1	Meter Lead		12450-98	48"	
1	Attenuator Adapter		1050-17		
1	Adapter Cable		3030-55	48"	

TECHNICAL CHARACTERISTICS

1. Power Supply Required: 105-125 V, 50-70 cycles, a-c.
   Other frequencies and voltages available by special request at slight additional cost.
2. Power Consumption: 35 watts at 115 volts.
3. Variable R-F Oscillator Frequency Range:
   a. A Band—125-325 kc.
   b. B Band—325-890 kc.
   c. C Band—890 kc. to 2.4 mc.
   d. D Band—2.4 to 6.9 mc.
   e. E Band—6.9 to 20 mc.
   f. F Band—20 to 70 mc.
   g. G Band—70 to 120 mc.
   h. H Band—150 to 220 mc. (292X)
      H Band—120 to 165 mc. (292X-AL)
4. Crystal Controlled R-F Oscillator Frequency Range:
   a. 1000 kc.—crystal supplied with instrument.
5. A-F Oscillator (Modulator) Frequency: 400 cycles.
6. Output Voltages:
   a. A-F: variable, 0-2 volts, maximum.
   b. Pure R-F; variable, calibrated from .5-100,000 microvolts.
   c. Modulated R-F: variable, calibrated from .5-100,000 microvolts.
   d. With 20DB pad, above voltages divided by 10.
7. Accuracy of Calibration:
   a. Variable R-F Oscillator: 1% on all ranges.
   b. 1000 kc. crystal controlled oscillator: 0.05%.
   c. 400 Cycle A-F Oscillator: 10%.
8. Modulation.
   a. 30% approximately, at 400 cycles, fixed.
   b. External modulation, variable.
9. Output Impedances:

a. 1-10 microvolts	5.6 ohms	d. 0-10,000 microvolts	20 ohms
b. 0-100 microvolts	5.6 ohms	e. 0-100,000 microvolts	0-100 ohms
c. 0-1000 microvolts	5.6 ohms		

10. Meter Ranges:
    a. Decibels: —10 to +6, +6 to +22, +22 to +38
    b. Special calibration points provided for setting the level of the R-F input to the attenuator.
11. Tube Complement:

	Tube	*Stock No.*	*Function*
V1	6AB4	20875-99	Variable R-F Osc. (H Band)
V2	6J6	20875-71	Variable R-F Osc. (Bands A through G)
V3	6SN7GT	20875-19	Audio Osc.-Modulator
V4	6SG7	20875-63	Ext. Xtal Osc.
V5	6X5GT/G	20875-22	Full-Wave Rectifier
	#47 G. E.	12270-12	Pilot Light

STANDARD EIA GUARANTEE

The Hickok Electrical Instrument Company warrants instruments manufactured by it to be free from defective material or factory workmanship and agrees to repair such instruments which, under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any instrument or test equipment which proves to be defective, when returned to us transportation prepaid, within 90 days from the date of original purchase, and provided the serial number has been made known to us promptly for our records.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or service stations in any way so as, in our judgment, to injure their stability or reliability, or which have been subject to misuse, negligence, or accident, or which have had the serial number altered, effaced or removed. Neither does this warranty apply to any of our products which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories, including all vacuum tubes not of our manufacture, used with this product are not covered by this warranty.

This warranty is in lieu of all other warranties expressed or implied, and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

Parts will be made available for a minimum period of five years after the manufacture of this equipment has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, etc., which have been furnished in the standard model.

RETURNING EQUIPMENT FOR REPAIR

Before returning any equipment for service, under warranty or otherwise, the factory must first be contacted giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Upon authorization, this equipment should be forwarded directly to the Hickok factory address, 10636 Leuer Avenue, Cleveland, Ohio, or to a designated service station in your locality. All correspondence pertaining to repairs should be directed to the Hickok office address, 10514 Dupont Avenue, Cleveland 8, Ohio, or to the authorized service station designated.

REGISTRATION CARD

The above guarantee is contingent upon the attached registration card being returned to the factory immediately upon receipt of the equipment.

Copyright 1960

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
Cleveland, Ohio

SECTION I—DESCRIPTION

1.1 PURPOSE

a. The Hickok Crystal Controlled Microvolt Signal Generator, Model 292X, is an accurate portable signal generator which provides a source of variable radio frequencies from 125 kc. to 120 mc. and from 150 to 220 mc. on fundamentals. The output voltages are calibrated within the limits of one-half microvolt to 100 000 microvolts by means of both a step and a continuously variable microvolt control. The output may be modulated at 30%.

b. In addition to the continuously variable output, a crystal oscillator circuit is included in the 292X into which crystals between the ranges of 1 mc. and 20 mc. may be connected. The 1 mc. crystal is included with the instrument and will provide frequencies at 1 mc. and harmonics of this frequency. The crystal oscillator may be either modulated or unmodulated.

c. A 400 cycle fixed audio frequency is also available and may be varied continuously from zero to approximately 2 volts, maximum, by the output multiplier network.

1.2 BRIEF DESCRIPTION

a. PHYSICAL

The Model 292X, illustrated in Figure 1.1, is housed in a welded steel case finished in blue Hammertex finish, and provided with a folding bail-type steel handle. Four feet are provided on both bottom and back so that the instrument may be used either vertically or horizontally. Frequency calibration is on an 8 inch etched dial which may be driven directly by means of a large knob in the center, or from a vernier drive (giving a reduction ratio of approximately 50 to 1) located at the lower edge of the main dial. The vernier drive may be completely disengaged from the main drive by pulling forward and rotating the knob. Other controls, scales and connections are clearly designated on the panel.

b. FUNCTIONAL

The Model 292X can be used to perform the following functions:

1. Alignment of radio receivers.

2. Selectivity and sensitivity measurements of radio receivers.

3. Gain-per-stage measurement in receivers.

4. Bridge measurements requiring a source of r-f or a-f voltage.

5. Any other tests or measurements which will need voltages such as those generated by the Model 292X.

c. ELECTRICAL

Figure 1.2 illustrates, in block form, the basic circuits utilized in the Model 292X.

d. COMPONENTS

Three leads, in addition to the a-c power cord which is permanently attached to the instrument, are furnished with the Model 292X. These are as follows:

1. A shielded coaxial output cable terminated at one end with two alligator clips and at the other end with a shielded single contact connector. The black alligator clip is used as the common ground for the signal output and the decibel meter. The red clip is for the signal output.

2. A 20 DB pad with coax cable connector is supplied for further attenuating the output by a factor of 10:1. This will be used in connection with very sensitive receivers which require a signal of .5 microvolt or less for alignment.

3. A rubber covered lead terminated at one end with a red alligator clip and at the other end with a tipped plug, is furnished for use in connection with the decibel meter.

1.3 MODEL 292X-AL (Airlines)

This instrument is identical to the standard 292X referenced throughout this instruction manual with the exception of the frequency coverage. The H Band, which in the standard model covers from 150 to 220 mc, has been changed to cover the airline frequency range. This band will cover from 120 to 165 mc.

Although all references in this manual are to the Model 292X, the operation of these two instruments is identical.

SECTION II—OPERATION AND ADJUSTMENT

2.1 INSTALLATION

a. Since the Model 292X signal generator is a portable test equipment, no permanent installation is required. In the rear of the case are ventilating louvers and the generator should be so located that free air can vent through the louvers.

2.2 PRELIMINARY CHECKS IN REGARD TO OPERATION

Some checks can be made without the necessity of additional equipment to determine if certain parts of the circuits are operating properly. These checks may be made as follows:

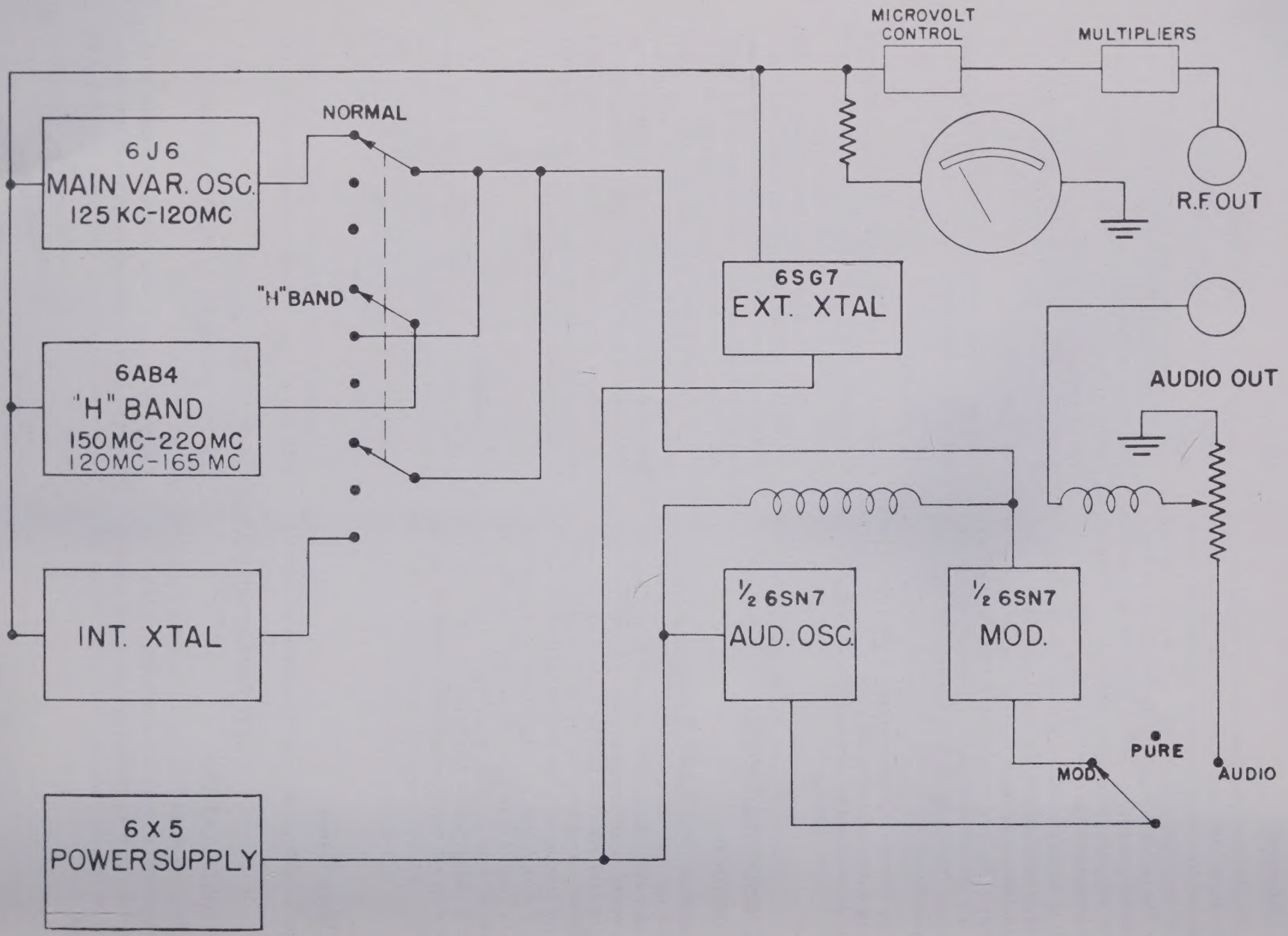


Figure 1.2—292X Block Diagram

a. Vernier Drive—The vernier drive located at the lower right hand side of the main dial is of the type which can be released to provide for rapid tuning of the main dial by means of the large central knob. This drive is released by holding the rear drive washer, i. e., the washer in back of the main tuning dial, and pulling forward on the knob, rotating it about 45° or more. To re-engage the vernier drive it is only necessary to reverse this process until the drive snaps into place giving it tension on the main tuning dial. This drive may be engaged or disengaged upon shipment of the instrument.

b. Plug the line cord into a suitable source of power, 50-70 cycles, 105-125 volts.

c. Operate the A-F output control clockwise which will turn the instrument on. The green STANDBY pilot light should light up immediately and with the STANDBY switch turned to the OPERATE position, the red OPERATE pilot light should light up.

d. Control Settings.

METER CIRCUIT SELECTOR . . . . . R. F. IND.
XTAL-BAND SELECTOR . . . . . Normal
OUTPUT SELECTOR . . . . . Mod. R. F. or Unmod. R. F.
OUTPUT MULTIPLIER . . . . . any position
MICROVOLTS . . . . . any position
BAND SELECTOR . . . . . First to OFF position

(No indication of the meter should be obtained.)

e. Rotate the BAND SELECTOR switch from band A through to band G and note if the MASTER ATTENUATOR control will bring the meter pointer up to the "A through G" position. In doing this, it should be noted that the G band covers only a partial arc of the entire dial. Therefore if it were turned to some part of this arc which was not on the calibrated scale no indication might be obtained.

f. Operate the BAND SELECTOR control to the H band and turn the XTAL-BAND SELECTOR control to H-BAND OSC. The MASTER ATTENUATOR control should then be capable of advancing the indicating meter to the "H" band position.

g. If the 292X is equipped with the internal mobile crystal unit and the crystal is installed, by turning the XTAL-BAND SELECTOR to the XTAL position and the BAND SELECTOR to the XTAL position, the MASTER ATTENUATOR should be advanced until the indicator is somewhere between one-fourth and one-half scale.

h. If the XTAL-BAND SELECTOR is turned to the XTAL position and the BAND SELECTOR to any band between A through H, inclusive, the MASTER ATTENUATOR will control the meter indication but the actual meter reading will be meaningless since it will be reading the sum of both the internal crystal voltage and the voltages from the main variable oscillator.

i. External Crystal—Plugging an external crystal into the EXT. XTAL socket on the panel of the instrument will provide for a crystal controlled output. The BAND SELECTOR and XTAL BAND SELECTOR switches must be turned to the XTAL position. The crystal output will then be taken from the R. F. OUTPUT jack controlled by the OUTPUT MULTIPLIER and MICROVOLTS controls. The MASTER ATTENUATOR control will also be effective in controlling the crystal output and it should be advanced to a point where the meter indicates at least ten divisions on the 0-100 scale with the METER CIRCUIT SELECTOR switch in the R. F. IND. position.

j. Further checks of the instrument would necessitate the use of auxiliary equipment such as radio receiver, cathode ray oscilloscope, frequency meter, etc.

2.3 OPERATION

To set the equipment up for operation, the type of output voltage required is first determined.

a. MODULATED R. F. OR UNMOD. R. F.—125 kc, to 120 mc.

OUTPUT SELECTOR—Mod. R. F. or Unmod. R. F. as desired.
BAND SELECTOR—to frequency range within which desired frequency falls.
MAIN TUNING DIAL—to desired frequency.
METER CIRCUIT SELECTOR—R. F. Ind.
OUTPUT CABLE—R. F. Output.
XTAL-BAND SELECTOR—Normal.
MASTER ATTENUATOR—With the exception of the F and G band, and with the R. F. Multiplier on X1, this control should be advanced until the meter indicates at point labeled 'All Other Bands" on the meter dial. When using the F and G band on R. F. X1, advance this control until the meter reads at point indicated as "F and G Band—R. F. X1".

IMPORTANT

Unless the MASTER ATTENUATOR is set as indicated above, slight frequency calibration error may be found as there is some interaction between the setting of the MASTER ATTENUATOR and the generated frequency.

OUTPUT MULTIPLIER—to desired output voltage.
MICROVOLTS—to desired output voltage.

b. MODULATED R. F. OR UNMOD. R. F.—150 to 220 mc.

All other controls and procedures identical to those listed previously with the following exceptions:

XTAL-BAND SELECTOR—H-Band Osc.
BAND SELECTOR—H Band.
MASTER ATTENUATOR—advanced to give meter indication at "H" band point on scale.

c. INTERNAL XTAL

As the 292X is supplied the internal Crystal unit illustrated in Figure 4.2 and referenced in Figure 1.2 is not supplied nor available.

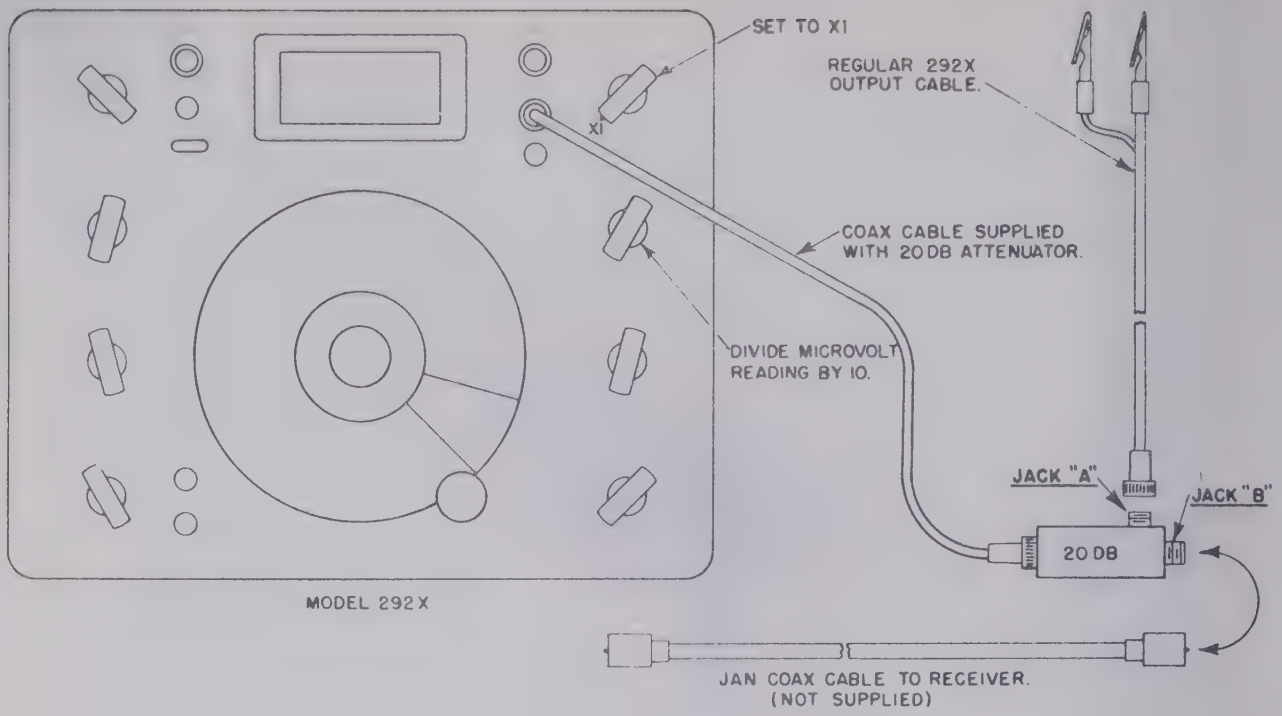


Figure 2.1—Type 20DB (10:1 Voltage) Attenuator

d. EXT. XTAL

1. The output from the EXT. XTAL is taken from the R. F. OUTPUT jack on the panel.

2 .OUTPUT SELECTOR switch may be turned to the UNMOD. R. F. EXT. MOD. or MOD. R. F. position.

3. BAND SELECTOR and XTAL-BAND SELECTOR switches should be turned to the XTAL position.

4. The OUTPUT MULTIPLIER and MICROVOLTS controls will attenuate the crystal output, and the MASTER ATTENUATOR is also effective in attenuating this output.

IMPORTANT

Since the crystal oscillator may not start to oscillate until the MASTER ATTENUATOR is advanced to approximately 50% rotation, start with this control at full clockwise rotation and then decrease if necessary to obtain suitable output.

5. Output voltage for a 1000 kc. crystal will be approximately 3 volts maximum at the fundamental frequency of 1000 kc.

6. Any crystal ground to a fundamental frequency between 500 kc. and 20 mc. may normally be used in place of the 1 mc. crystal supplied with the Model 292X.

e. 400 CYCLE AUDIO FREQ.

1. Audio frequency output is also taken from the A. F. OUTPUT panel connector.

2. Operate the OUTPUT SELECTOR control to the AUDIO FREQ. position.

3. The output voltage is controlled by the A. F. OUTPUT control and is variable to approximately 4 volts maximum.

f. EXTERNAL MODULATION OF MAIN VARIABLE OSCILLATOR—125 kc. to 120 mc.

1. OUTPUT SELECTOR switch turned to UNMOD. R. F., EXT. MOD. position.

2. Source of signal for EXT. MOD. is fed in between ground (from the output cable) and EXT. MOD. binding post. Approximately 4 volts will be required for 30% amplitude modulation at 1000 cycles.

g. DB METER—The indicator may be used as a 3 range decibel meter by turning the METER CIRCUIT SELECTOR to the desired DB range and feeding the signal in between ground and the METER pin jack on the panel.

h. 20 DB PAD—In a case of receivers having such a sensitivity that a signal of less than one microvolt is neces-

sary, the 20 DB pad may be connected as illustrated in Figure 2.1.

If the output is being fed to someplace in a receiver where it is more convenient to use alligator clips, connect the regular cable as supplied with the 292X to Jack "A". If the signal is being fed to a receiver having a JAN antenna input type receptacle, a cable can be made up so that coupling can be effected directly from the JAN connector "B" to the receiver input.

As a result of the use of this 20 DB or 10:1 voltage reduction pad, output voltage will be attenuated by a factor of ten to one. That is, with the OUTPUT MULTIPLIER set on X1 and the MICROVOLTS control at 10, the theoretical output will be approximately one-tenth of 10 microvolts or one microvolt. As the MICROVOLTS control is retarded toward 1, the microvolt output will be reduced to approximately .1 microvolt.

IMPORTANT

When the 292X is calibrated for frequency, the MASTER ATTENUATOR control is adjusted so that the meter reads in accordance with the instructions relative to the second red point on the scale, except as noted on the meter. If the meter is not set at this point, the frequency accuracy is liable to be impaired as there is an interaction between this control and the generated frequency.

i. OPERATE-STANDBY Switch—When this switch is turned to the STANDBY position the B+ voltage is removed from all tubes and only the heaters are maintained at operating temperature.

SECTION III—THEORY OF OPERATION

3.1 MAIN VARIABLE OSCILLATOR—125 kc. to 120 mc.

a. The type 6J6 tube with its two triodes tied in parallel is connected in a Colpitts type of circuit to the 7 coils comprising the tuning inductances for the frequencies within this range. These coils are adjusted by means of Hi-Q iron cores and negative temperature coefficient ceramic capacitors to give a high degree of accuracy to calibration throughout these frequencies.

b. A two-section variable air condenser geared to the main tuning dial adjusts the frequency within any range.

c. The output of these oscillators is monitored by the voltmeter and available at the R. F. OUTPUT jack.

3.2 H-BAND OSCILLATOR—150 to 220 mc.

a. A 6AB4 tube is connected in a Colpitts oscillator circuit to the inductance from this band. This inductance is tunable by a two-section variable air condenser on the same shaft with the variable condenser tuning throughout bands A through G, inclusive. The tube, condenser and inductance are permanently connected and in operation, B+ is applied only when the BAND SELECTOR is on the H band.

3.3 400 CYCLE OSCILLATOR-MODULATOR

a. One-half of a type 6SN7 tube is connected to an audio transformer and oscillates at 400 cycles. From this transformer, connection is made through the OUTPUT SELECTOR switch to permit this voltage to be applied to the other triode of the 6SN7 tube which is so connected as a modulator for the main variable oscillators discussed in paragraphs 3.1 and 3.2. This section of the 6SN7 can also be driven from an external modulating source as explained in paragraph 2.3.

b. The 400 cycle A. F. voltage is taken from the 400 cycle modulator available at the A. F. OUTPUT jack and controlled by the A. F. OUTPUT control.

3.4. EXT. XTAL

a. The type 6SG7 tube is connected in a crystal oscillator type of circuit to the EXT. XTAL jack on the front panel of the Model 292X.

3.5 MICROVOLT METERING CIRCUIT

The output level is established by means of a 1N34 crystal and associated meter. A level of approximately one volt is established as a reference to obtain proper calibration of the OUTPUT MULTIPLIER and MICROVOLTS controls.

3.6 OUTPUT MULTIPLIER—MICROVOLTS NETWORK

The OUTPUT MULTIPLIER consists of a 5-stage ladder attenuator, the voltage to which attenuator is controlled by the MICROVOLTS control. The output impedance of this circuit is constant at approximately 4 ohms on the X1, X10, and X100 ranges, and at approximately 20 ohms on the X1K range, and will vary from approximately zero to 100 ohms on the RF X10K range.

3.7 POWER SUPPLY

The power supply consists of a type 6X5 tube connected in full wave rectification and resistively filtered by electrolytic condensers and resistance. The primary of the power supply is filtered so that there will be a minimum of radio frequency leakage through the power supply line. The power supply also supplies heater voltages for the various tubes and pilot lights in the instrument.

3.8 D. B. METER

The three range DB meter utilizes copper-oxide rectifiers and is calibrated on the basis of 0 DB equals 6 milliwatts on a 500 ohm line.

SECTION IV—MAINTENANCE

4.1 GENERAL

As the Model 292X has been built in accordance with the Hickok high standards of quality, material and workmanship, no maintenance other than routine checks should be necessary. A schematic wiring diagram is given in Figure 6.1 and chassis views are given in Figures 4.1 and 4.2 to aid in the location of component parts for trouble-shooting and replacement, if necessary. In the event that trouble occurs, it is suggested that our engineering staff be consulted as they are glad to give any assistance possible. It is requested that the suggestions given in "Returning Equipment for Repair", page vi, be followed if it becomes necessary to return the unit.

4.2 TUBE MAINTENANCE

Failure in operation in most cases is likely to be caused by failure of tubes. These tubes are operated well within their ratings to insure long life but may, in time, need replacing. All tubes except V1 and V2, both type 6J6, which are the variable oscillators, may be removed when the unit is removed from the case. To remove V1 and V2, remove the r-f shield first. The type 6J6, V1 or V2, is a miniature type tube and has special type shield which must be removed first. To do this, turn the shield slightly to release the catch and then lift straight off.

4.3 REALIGNMENT

When V1, the high frequency oscillator tube, is replaced, the characteristics of the new tube may differ sufficiently from the replaced tube to necessitate realignment of the instrument. Vary spacing of the coil (located in condenser housing) to vary the low end of the H band. At the high frequency end of the band a negative coefficient ceramic capacitor is used.

When V2 is replaced, the characteristics of this tube may vary sufficiently from the replaced tube to necessitate realignment of the unit. If this is the case, a variable powdered iron core inductor at the low frequency end of the band and a negative coefficient ceramic capacitor at the high end of the band will be required for realignment.

The Model 292X is a high precision type of instrument and will require suitable standards to make any type of realignment.

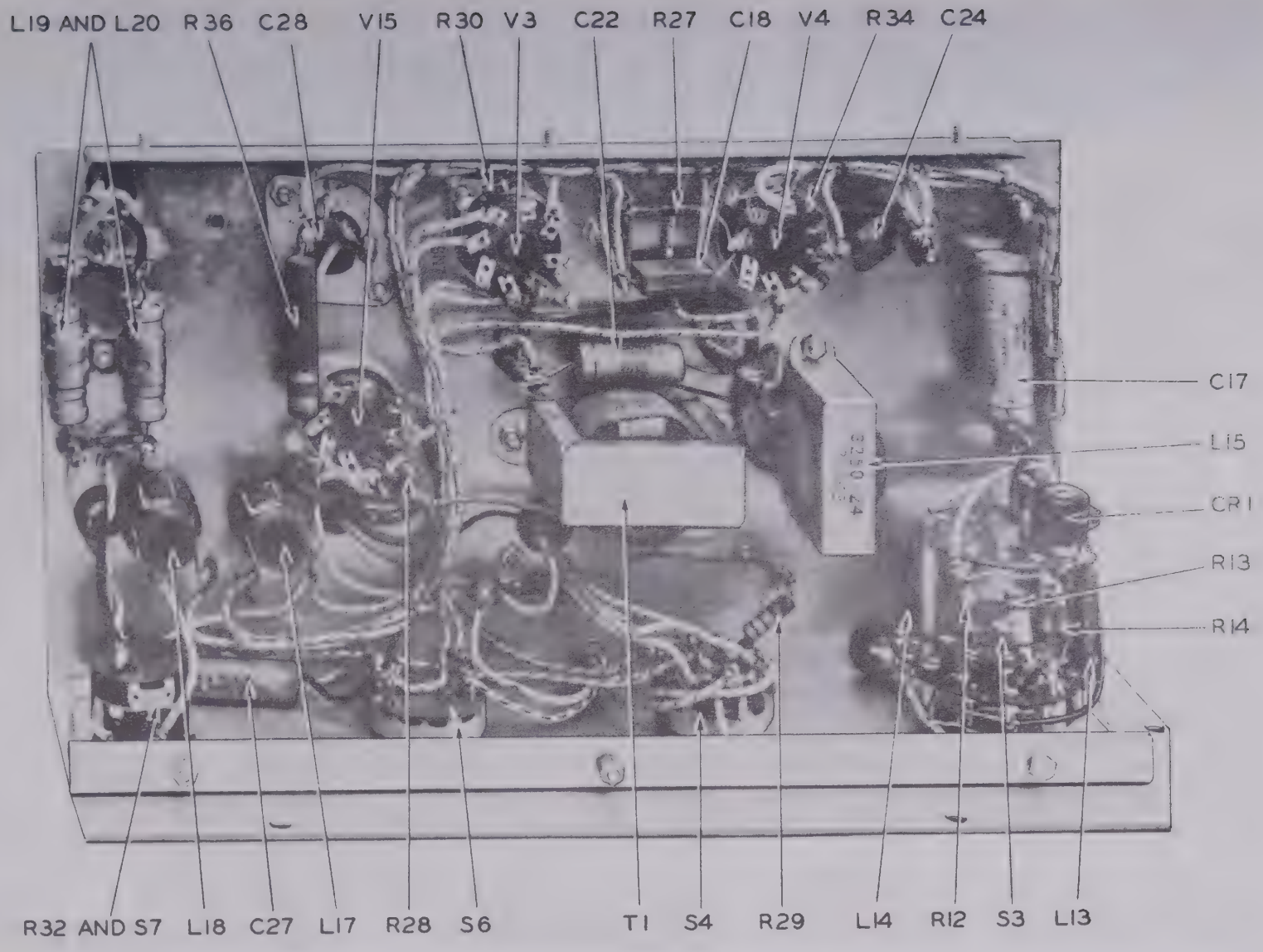


Figure 4.1—Power Supply Chassis, Model 292X

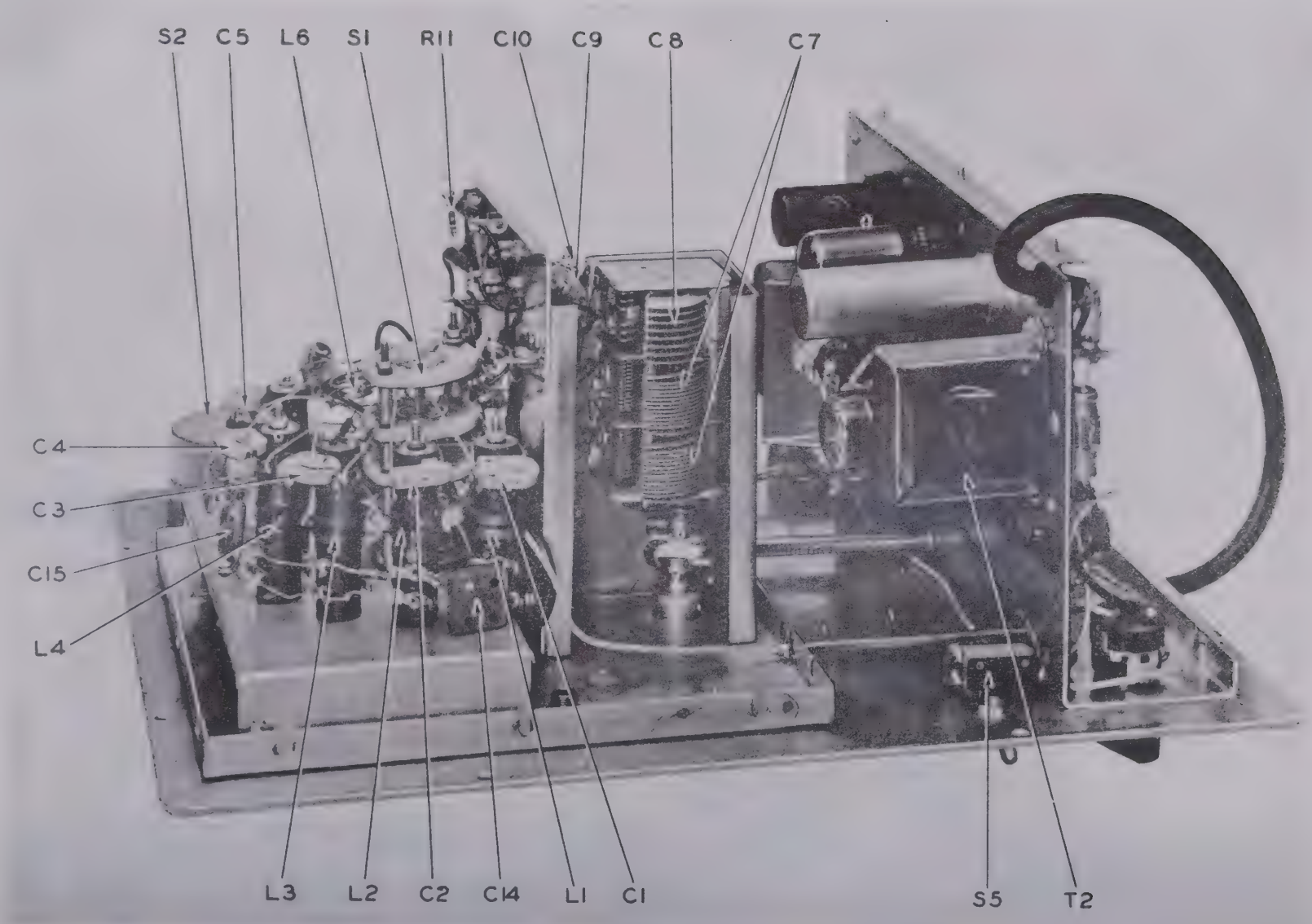


Figure 4.2—R-F Chassis, Model 292X, Right View

SECTION V—PARTS LIST

PARTS LIST FOR MODEL 292X

NOTE: There is a minimum charge of $1.50 for shipment of any one order.

REF. SYMBOL	HICKOK CODE NO.	NAME AND DESCRIPTION	FUNCTION
C1	3115-1	CAPACITOR: 3-12 mmf. trimmer, ceramic	
C2		CAPACITOR: Same as C1	
C3		CAPACITOR: Same as C1	
C4		CAPACITOR: Same as C1	
C5		CAPACITOR: Same as C1	
C6		CAPACITOR: Same as C1	
C7	3120-19	CAPACITOR: 11-438 mf (2 sec. variable) (C7 & C8 in one housing)	
C8		CAPACITOR: 6-35 mmf (See C7)	
C9		CAPACITOR: Same as C1	
C10	3110-5	CAPACITOR: 20 mmf, 500 wvdc, 10%, ceramic	
C11	3095-9	CAPACITOR: .001 mfd, 500 V, 10%, mica	
C12	3095-41	CAPACITOR: 2700 mmf, 500 V, 10%, mica	
C13	3110-1	CAPACITOR: 50 mmf, 0 temp. coef., ceramic	
C14	3095-17	CAPACITOR: .0047 mfd, 500 V, 10%, mica	
C15	3095-8	CAPACITOR: 470 mmf, 500 V, 10%, mica	
C16	3105-13	CAPACITOR: .25 mfd, 400 V, paper	
C17	3105-15	CAPACITOR: .5 mfd, 400 V, paper	
C18		CAPACITOR: Same as C11	
C19	3095-5	CAPACITOR: 100 mmf, 500 V, 10%, mica	
C20	3105-4	CAPACITOR: .01 mfd, 400 V, paper	
C21	3105-7	CAPACITOR: .025 mfd, 400 V, paper	
C22	3105-24	CAPACITOR: .1mfd, 400 V, paper	
C24		CAPACITOR: Same as C20	
C25		CAPACITOR: Same as C15	
C26		CAPACITOR: Same as C15	
C27	3105-9	CAPACITOR: .05 mfd, 400 V, paper	
C28	3085-7	CAPACITOR: 20-20 mfd, 450 V, 10%, electrolytic	
C29		CAPACITOR: Same as C15	
L1	3320-22	COIL: Ass'y, Osc. "A"	
L2	3320-23	COIL: Ass'y, Osc. "B"	
L3	3320-24	COIL: Ass'y, Osc. "C"	
L4	3320-25	COIL: Ass'y, Osc. "D"	
L5	3320-26	COIL: Ass'y, Osc. "E"	
L6	3320-62	COIL: Ass'y, Osc. "F"	
L7	3320-28	COIL: Ass'y, Osc. "G"	
L8	3320-58	COIL: Ass'y, Osc. "H"	
L9	3250-23	CHOKE: 25 turns #36 S. S. E.	
L10		CHOKE: Same as L9	
L11		CHOKE: Same as L9	
L12	3250-17	CHOKE: 50 turns #32 S. S. E.	
L13		CHOKE: Same as L12	
L14		CHOKE: Same as L12	
L15	3250-24	CHOKE: Modulation	
L16	3250-5	CHOKE: #26 tinned copper	
L17	3320-57	COIL: Ass'y	
L18		COIL: Ass'y, Same as L17	

Prices will be furnished upon request.

PARTS LIST FOR MODEL 292X

NOTE: There is a minimum charge of $1.50 for shipment of any one order.

REF. SYMBOL	HICKOK CODE NO.	NAME AND DESCRIPTION	FUNCTION
L19	3105-122	COIL: R-F filter	
L20		COIL: Same as L19	
L21	3250-27	CHOKE: Ass'y, 20 turns #30 P. E.	
L22		CHOKE: Same as L21	
L23		CHOKE: Same as L12	
L24		CHOKE: Same as L12	
L25		CHOKE: Same as L12	
R6	16925-100	POTENTIOMETER: 200 ohms, linear, carbon	MICROVOLTS
R25	16925-77	POTENTIOMETER: 50,000 ohms, linear, carbon	MASTER ATTENUATOR
R32	(S7) 16925-75	POTENTIOMETER: 10,000 ohms, linear, carbon, with switch	A-F OUTPUT
R1	18411-182	RESISTOR: 180 ohm, ½ W, 10%	
R2	18411-181	RESISTOR: 180 ohm, ½ W, 5%	
R3	18410-471	RESISTOR: 47 ohm, ½ W, 5%	
R4		RESISTOR: Same as R3	
R5		RESISTOR: Same as R3	
R7	18410-331	RESISTOR: 33 ohm, ½ W, 5%	
R8	18450-39	RESISTOR: 5.6 ohm, ½ W, 5%	
R9		RESISTOR: Same as R8	
R10		RESISTOR: Same as R8	
R11	18413-471	RESISTOR: 47,000 ohm, ½ W, 5%	
R12	18414-681	RESISTOR: 680,000 ohm, ½ W, 5%	
R13	18414-111	RESISTOR: 110,000 ohm, ½ W, 5%	
R14	18413-241	RESISTOR: 24,000 ohm, ½ W, 5%	
R15	18411-471	RESISTOR: 470 ohm, ½ W, 5%	
R16	18411-152	RESISTOR: 150 ohm, ½ W, 10%	
R17		RESISTOR: Same as R15	
R18	18411-222	RESISTOR: 220 ohm, ½ W, 10%	
R20	18412-471	RESISTOR: 4700 ohm, ½ W, 5%	
R21	18413-102	RESISTOR: 10,000 ohm, ½ W, 10%	
R22	18412-331	RESISTOR: 3300 ohm, ½ W, 5%	
R23		RESISTOR: Same as R21	
R24		RESISTOR: Same as R20	
R26		RESISTOR: Same as R11	
R27		RESISTOR: Same as R21	
R28		RESISTOR: Same as R20	
R29	18412-182	RESISTOR: 1800 ohm, ½ W, 10%	
R30	18412-222	RESISTOR: 2200 ohm, ½ W, 10%	
R31	18412-392	RESISTOR: 3900 ohms, ½ W, 10%	
R33	18413-101	RESISTOR: 10,000 ohm, ½ W, 5%	
R34	18414-271	RESISTOR: 270,000 ohm, ½ W, 5%	
R35	18414-472	RESISTOR: 470,000 ohm, ½ W, 10%	
R36	18432-182	RESISTOR: 1800 ohm, 2 W, 10%	
S1	19912-107	SWITCH: 4 sec, 10 pos, rotary	BAND SELECTOR
S2	19912-106	SWITCH: 1 sec, 5 pos, rotary	OUTPUT MULTIPLIER
S3	19912-254	SWITCH: 4 pole, 4 pos, rotary	METER CIR. SEL.
S4	19912-62	SWITCH: 1 sec, 3 pos, 4 pole, rotary	XTAL BAND SEL.
S5	19911-17	SWITCH: DPST, toggle	STANDBY-OPERATE
S6	19912-163	SWITCH: 2 pole, 3 pos	OUTPUT SELECTOR
S7 (R32)		SWITCH: Available only on potentiometer R32	POWER ON-OFF

Prices will be furnished upon request.

PARTS LIST FOR MODEL 292X

NOTE: There is a minimum charge of $1.50 for shipment of any one order.

REF. SYMBOL	HICKOK CODE NO.	NAME AND DESCRIPTION	FUNCTION
T1	20800-93	TRANSFORMER: Audio Freq.	
T2	20800-102	TRANSFORMER: Power	
V1	20875-99	TUBE: 6AB4	
V2	20875-71	TUBE: 6J6	
V3	20875-19	TUBE: 6SN7GT	
V4	20875-63	TUBE: 6SG7	
V5	20875-22	TUBE: 6X5GT/G	
	1050-17	ADAPTER: Attenuator	
	3030-41	CABLE: Assembly	METER LEAD
	3870-20	CRYSTAL: 1000 kc, .05%, FT-243 holder	
	11500-2	KNOB: 3" skirt, phenolic	FREQ. SCALE
	11500-11	KNOB: Hickok bar with pointer	
	11505-9	KNOB: 1" drive knob	VERNIER
	12270-12	LAMP: #47 G. E., 6-8 V, .15 amp.	PILOT
CR1	18150-10	RECTIFIER: Double half-wave	
CR2	3870-2	CRYSTAL: Sylvania Type 1N34	

Prices will be furnished upon request.

REPLACEMENT PARTS FOR ADAPTER 1050-17

3030-55	CABLE ASS'Y: Coaxial type
18410-471	RESISTOR: 47 ohm, ½ W, 5%—Quan. 2
18411-271	RESISTOR: 270 ohm, ½ W, 5%—Quan. 1

NOTE

In ordering parts or material for this instrument, the serial number must be given in order to identify properly the material required.

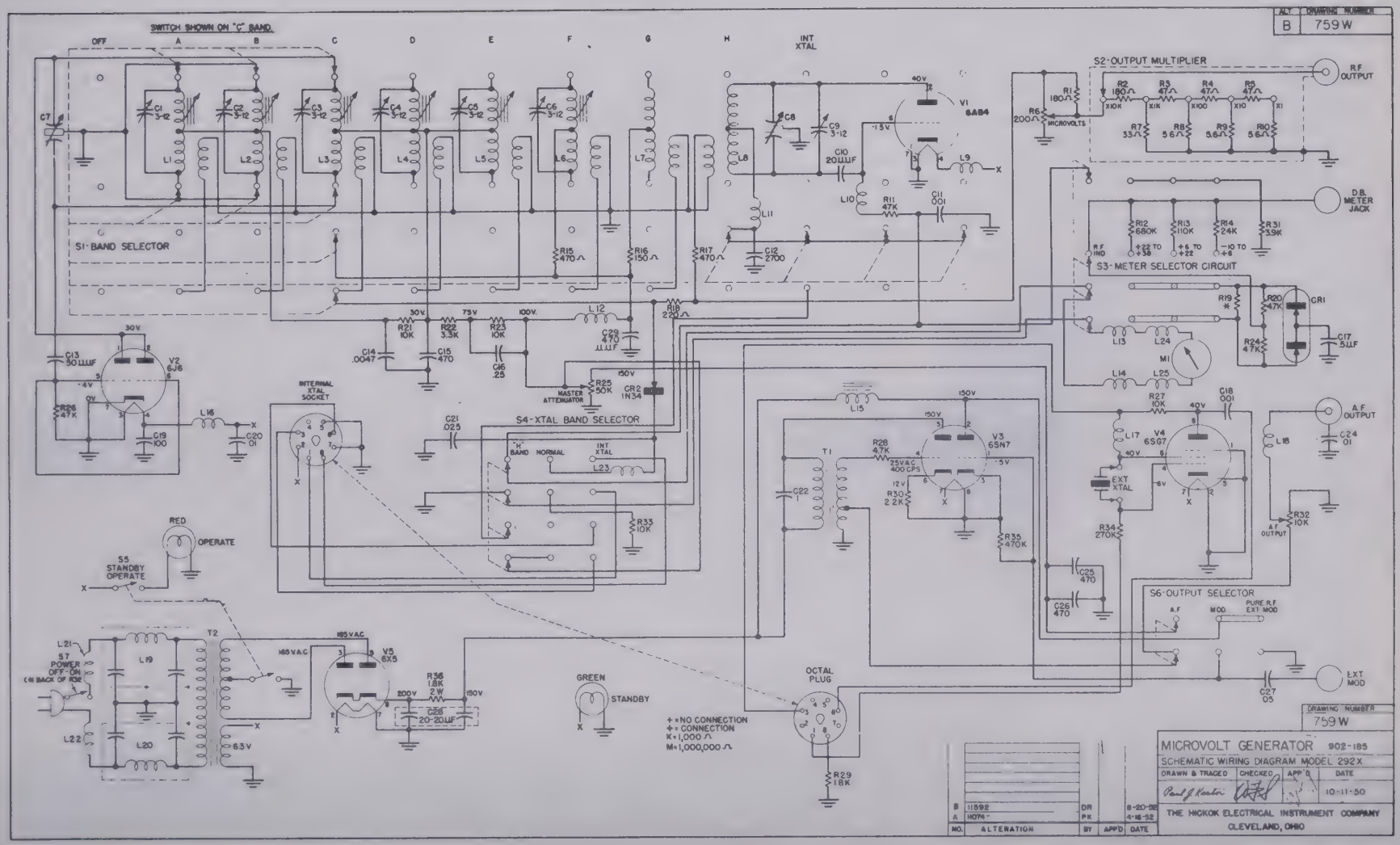


Figure 6.1—Schematic, Model 292X